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S190 INTERPRETATION TECHNIQUES DEVELOPMENT AND APPLICATION TO NEW YORK STATE WATER RESOURCES

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Summary

The objective of this investigation is development of interpretation techniques for satellite monitoring of lake eutrophication. Imagery from the S190 and S190B experiments is to be utilized to study eutrophication processes in three lakes important to New York State water resources: Lake Ontario, Conesus Lake and Chautauqua Lake.

During this reporting period plans for the ground and aircraft underflight data gathering were outlined in detail, and the first ground and aerial data collection mission was successfully conducted during the period 4-7 May. The second such mission, planned for Skylab-2 data passes, was cancelled when the Skylab-2 data passes did not occur. Delays in the Skylab-1 and 2 efforts also caused aircraft scheduling problems which necessitated construction of a camera mount for a second aircraft, in order to fulfill Skylab-1 and 2 aircraft underflight commitments.

The plans for the next reporting period are as follows. Four data missions are scheduled for the latter parts of June, July, August and September. Two to three of these missions are to be concurrent with Skylab 3 data passes. Analyses of the aerial imagery will begin. The aerial data base for the program includes imagery of Conesus Lake obtained during July, August and September of 1972, and imagery of Lake Ontario obtained at monthly intervals during the period May to September, 1972. By the end of the next reporting period analyses are expected to be completed on the 1972 data, as well as the May, June and July 1973 data. While no Skylab-2 data were obtained over our test site, the extensive aircraft data base of 1972 and 1973 will allow analyses of eutrophication indices to continue until Skylab-3 and 4 imagery becomes available.

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Discussion

One of the principal questions to be resolved in development of interpretation techniques for satellite measurement of eutrophication indices is whether optical data for large lakes or lake systems can be obtained with sufficient accuracy for these data to be useful as eutrophication indices. We are currently investigating this question for aircraft imagery as part of a program on the International Field Year on the Great Lakes (IFYGL), sponsored by the National Science Foundation.[1]

Preliminary results of the IFYGL investigation indicate that sufficient accuracy can be obtained with careful photometry. The major problem is that, at higher altitudes, up to approximately one-half of the sensor signal is unrelated to lake reflectance, being caused by atmospheric effects.[2] As a result small changes in illumination or atmospheric conditions make analyses of lake data from different times of a seasonal cycle, or from different years, extremely difficult. The illumination and atmospheric problems are being resolved using a shadow calibration technique, and microdensitometry through a specially constructed stereoscope-microdensitometer.[3] Similar analyses are to be applied to the S190 and S190B imagery to determine the impact of such phenomena on satellite measurements of eutrophication.

Data for evaluation of optical eutrophication indices will be taken at intervals of about one month during the period May-November 1973. Surface data will be collected on Conesus and Chautauqua Lakes. During a Skylab pass both lakes are sampled; during other missions only Conesus Lake is sampled. The surface measurements include Secchi disk readings, transmissometer measurements of total attenuation, spectrally filtered measurements of relative irradiance, and water sampling for chlorophyll content. Five sampling stations have been chosen for Conesus Lake, and seven for Chautauqua Lake.

The transmissometer spectral response is that of a Type 5 CdS photocell. The transmissometer is lowered in a horizontal mode, with readings taken at one meter intervals to lake bottom. The irradiance meter spectral response is that of a PIN6D photodetector, coupled to a sandwich of Kodak Infrared Rejection Filters Series No. 305 and No. 301. Irradiance measurements are made at one meter intervals to 10^{-3} surface irradiance through Wratten filters Nos. 92 (red), 93 (green) and 94 (blue). Water samples are obtained from the first meter, and are filtered through Millipore filters for analysis of chlorophyll content.

Imagery is being taken of Conesus, Chautauqua, Canadice and Honeyoe Lakes, as well as those portions of Lake Ontario contained in the flightlines between Olcott, NY and Gold Pt., Ontario, and between Chub Pt., Ontario and Troutberg, NY. Flight altitude is 8000 feet, and resulting image scale is 1:32,000 with 80 mm lenses. Four Hasselblad 500 EL cameras are being utilized with Ektachrome MS2448 and SO242 film types. Each film type is processed with a 5500°K and 13000°K colloidal suspension M type carbon step wedge. Stereo imagery is obtained with approximately 60% overlap.

The first of the seven monthly surface and aerial data collection missions was successfully completed on 4 and 7 May. The purpose of the mission was to collect early lake data, and to provide a simulation and system test for the Skylab-2 mission. Surface data were obtained for Conesus Lake only; aerial data were obtained for all lakes except Ontario.

The Secchi disk, transmissometer and water sampling proceeded as scheduled, with only the relative irradiance meter malfunctioning. The problem with the irradiance meter has since been corrected. A successful set of aerial data was obtained; preliminary analysis of these data indicates excellent correlation with the surface data.

Original plans were to utilize the above camera configuration within the Calspan Piper Aztec C aircraft during Skylab overflight. Delay of Skylab launch and EREP data take brought the aircraft underflight commitment to a time period in which the Aztec aircraft was unavailable due to other contractual commitments. A special camera mount for Calspan's B-26 aircraft was therefore constructed.

Activities During the Next Reporting Period

Surface and aerial data collection and analysis will be fully underway. Four data gathering missions are anticipated--one each month from June to September. Data reduction of 1972 data and the 1973 May through July data should be completed.

References

(1) "Optical Properties of Lake Ontario Waters," National Science Foundation Grants GA-32207 and GA-37768.

(2) "Optical Properties of Lake Ontario Waters--First Calendar Year Progress Report," K. R. Piech, Calspan Corporation Report No. KS-5108-M-1, November 1972.

(3) "Thematic Mapping of Flooded Acreage," K. R. Piech and J. E. Walker, Photogrammetric Engineering, November 1972, pp. 1081-1090.